Electromagnetic Compatibility Test Report

Tests Performed on a Mobius Bionics LLC

2.4 GHz Transceiver, Model DKLU-10521-652

Radiometrics Document RP-8463A

ACCREDITED
TESTING CERT #1495.01

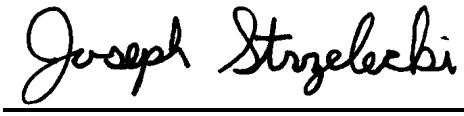
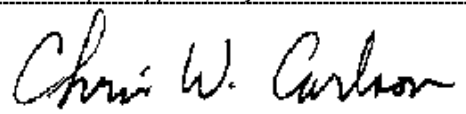
Product Detail:	
FCC ID: 2AJ4M10112 Equipment type: 2.4 GHz Low power transmitter	
Test Standards:	
US CFR Title 47, Chapter I, FCC Part 15 Subpart C FCC Part 15 CFR Title 47: 2016 This report concerns: Original Grant for Certification FCC Part 15.249	
Tests Performed For:	*Test Facility:*
Mobius Bionics LLC 470 Commercial St. Manchester, NH 03101	**Radiometrics Midwest Corporation** 12 Devonwood Avenue Romeoville, IL 60446-1349 (815) 293-0772
Test Date(s): (Month-Day-Year)	
November 5 to December 16, 2016	

Document RP-8463A Revisions:

Rev.	Issue Date	Affected Sections	Revised By
0	January 19, 2017		
1	January 30, 2017	6, 10.0, 11.2.3.1 & 11.2.3.2	Joseph Strzelecki

Table of Contents

1.0 ADMINISTRATIVE DATA

Equipment Under Test:	
A Mobius Bionics LLC, 2.4 GHz Transceiver Model: DKLU-10521-652 Serial Number: ARM-Q0-031 This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: (Month-Day-Year)	*Test Date(s): (Month-Day-Year)*
November 2, 2016	November 5 to December 16, 2016
Test Report Written By:	*Test Witnessed By:*
Joseph Strzelecki Senior EMC Engineer	The tests were not witnessed by Mobius Bionics LLC
Radiometrics' Personnel Responsible for Test:	*Test Report Approved By*
 Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	 Chris W. Carlson Director of Engineering NARTE EMC-000921-NE

2.0 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a 2.4 GHz Transceiver, Model DKLU-10521-652, manufactured by Mobius Bionics LLC. The detailed test results are presented in a separate section. The following is a summary of the test results.

Emissions Tests Results

Environmental Phenomena	Frequency Range	Basic Standard	Test Result
RF Radiated Emissions	30-25,000 MHz	FCC Part 15	Pass
Conducted Emissions, AC Mains	0.15 - 30 MHz	FCC Part 15	Pass
Occupied Bandwidth Test	Fundamental Freq.	FCC Part 15	Pass

2.1 RF Exposure Compliance Requirements

Since the power output is less than10 mW, the EUT meets the FCC requirement for RF. There are no power level adjustments available to the end user. The antenna is permanently attached. The detailed calculations for RF Exposure are presented in a separate document.

3.0 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a transmitter for a prosthetic arm, Model DKLU-10521-652, manufactured by Mobius Bionics LLC. The EUT was in good working condition during the tests, with no known defects. There are two identical transmitters in the arm. The two transmitters are identified as MSP1 and MSP2 herein. The two transmitters have the same electronics, with different antennas.

3.1.1 FCC Section 15.203 Antenna Requirements

The antenna is internal to the EUT and it is not readily available to be modified by the end user. Therefore, it meets the 15.203 Requirements.

3.2 Related Submittals

The associated transceiver is operated under part 15.249. It is subject to the FCC requirements pursuant to the Certification equipment authorization under Part 15 Subpart C, and is being submitted as FCC ID: 2AJ4M20260 and 2AJ4M20275.

4.0 TESTED SYSTEM DETAILS

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations. The EUT was tested while connected to its charger, since this is the worst-case configuration.

The identification for all equipment, plus descriptions of all cables used in the tested system, are:

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	Transcievers in prosthetic Arm; MSP1 & MSP2	E	Mobius	DKLU-10521-652	ARM-Q0-031
2	AC Adaptor	E	XP Power	AFM6OUS24C2	1036-00435
3	Laptop Computer	S	Lenovo	T430	PB-ZYMDV
4	Laptop power supply	S	Lenovo	T430	11592P1109Z1Z787AD4

* Type: E = EUT, P = Peripheral, S = Support Equipment; H = Host Computer

List of System Cables

QTY	Length (m)	Cable Description	Shielded?
1	1.8	AC Cord to input of Charger	No
1	1.0	DC output cable of charger	No
1	1.0	Battery Cable	No
1	1.0	Sensor Cable	No

4.2 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

4.3 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

5.0 TEST SPECIFICATIONS

Document	Date	Title
FCC CFR Title 47	2016	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices

6.0 TEST PROCEDURE DOCUMENTS

The tests were performed using the procedures from the following specifications:

Document	Date	Title
ANSI C63.4-2014	2014	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	2013	American National Standard for Testing Unlicensed Wireless Devices

7.0 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 2005 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the test methods listed herein. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la2.org).

The following is a list of shielded enclosures located in Romeoville, Illinois used during the tests:

Chamber E: Is a custom made anechoic chamber that measures 52' L X 30' W X 18' H. The walls and ceiling are fully lined with RF absorber. Pro-shield of Collinsville, Oklahoma manufactured the chamber. The floor has a 9' x 9' section of microwave absorber for testing above 1 GHz.

Test Station F: Is an area that measures 10' D X 12' W X 10' H. The floor and back wall are metal shielded. This area is used for conducted emissions measurements.

A separate ten-foot long, brass plated, steel ground rod attached via a 6 inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

The FCC has accepted these sites as test site number US1065. The FCC test site Registration Number is 732175. Details of the site characteristics are on file with the Industry Canada as site number IC 8727A-1.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

8.0 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

9.0 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification and the data contained herein was taken with calibrated test equipment. The results relate only to the EUT listed herein.

10.0 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
AMP-05	RMC/Celeritek	Pre-amplifier	MW110G	1001	1.0-12GHz	12 Mo.	01/05/16
AMP-20	Avantek	Pre-amplifier	SF8-0652	15221	8-18GHz	12 Mo	01/05/16
AMP-22	Anritsu	Pre-amplifier	MH648A	M23969	0.1-1200MHz	12 Mo.	01/05/16
AMP-29	HP / Agilent	Amplifier	11975A	2304A00158	2-8 GHz	12 Mo.	01/08/16
ANT-04	Tensor	Biconical Antenna	4104	2246	20-250MHz	24 Mo.	05/16/16
ANT-08	RMC	Log-Periodic Ant.	LP1000	1002	200-1000MHz	24 Mo.	10/06/16
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	12/28/16
ANT-36	Ailtech (Eaton)	Horn Antenna	96001	2013	1.0-18GHz	24 Mo.	11/02/16
ANT-48	RMC	Std Gain Horn	HW2020	1001	18-26 GHz	24 Mo.	12/15/15
HPF-01	Solar	High Pass Filter	7930-100	HPF-1	0.15-30MHz	24 Mo.	03/15/16
LSN-01	Electrometrics	50 uH LISN	FCC/VDE 50/2	1001	0.01-30MHz	24 Mo.	06/23/15
MXR-02	HP / Agilent	Harmonic Mixer	11970K	2332A00489	18-26.5GHz	12 Mo.	01/08/16
REC-08	HP / Agilent	Spectrum Analyzer	8566B	2648A13481 2209A01436	30Hz-22GHz	24 Mo.	12/21/15
REC-11	HP / Agilent	Spectrum Analyzer	E7405A	US39110103	9Hz-26.5GHz	12 Mo	03/23/16
REC-20	HP / Agilent	Spectrum Analyzer	85460A/84562A	33330A00135 3410A00178	30Hz-6GHz	24 Mo.	07/13/16
REC-21	Agilent	Spectrum Analyzer	E7405A	MY45118341	9Hz-26.5 GHz	24 Mo.	12/22/15
THM-02	Fluke	Temp/Humid Meter	971	93490471	N/A	24 Mo.	08/03/15
THM-03	Fluke	Temp/Humid Meter	971	95850465	N/A	12 Mo.	01/11/16

Note: All calibrated equipment is subject to periodic checks.

Software Company	Test Software Name	Version	Applicable Tests
Radiometrics	EN550XX0	06.10.16	RF Conducted Emissions (FCC Part 15 & EN 55011/22) REC-10
Radiometrics	REREC11D	01.05.16	RF Radiated Emissions (FCC Part 15 & EN 55011/22)
Agilent	PSA/ESA-E/L/EMC	2.4.0.42	Bandwidth and screen shots

11.0 TEST SECTIONS

11.1 AC Conducted Emissions

The tests and limits are in accordance with FCC section 15.207.

A computer-controlled analyzer was used to perform the conducted emissions measurements. The frequency range was divided into 500 subranges equally spaced on a logarithmic scale. The computer recorded the peak of each subrange. This data was then plotted on a semi-log graph generated by the computer. Adjusting the positions of the cables and orientation of the test system then maximizes the highest emissions.

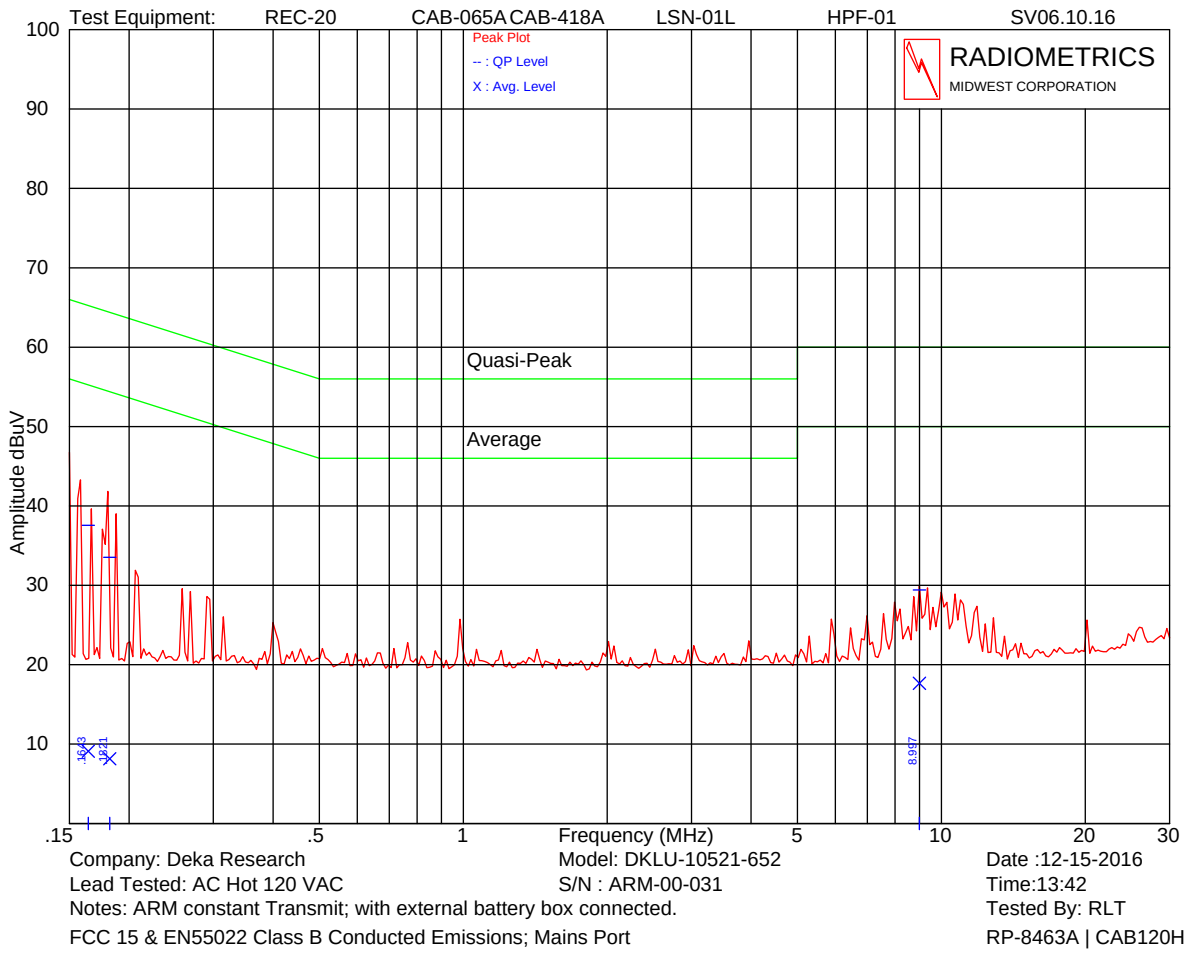
Mains Conducted emission measurements were performed using a 50 Ohm/50 uH Line Impedance Stabilization Network (LISN) as the pick-up device. Measurements were repeated on both leads within the power cord. If the EUT power cord exceeded 80 cm in length, the excess length of the power cord was made into a 30 to 40 cm bundle near the center of the cord. The LISN was placed on the floor at the base of the test platform and electrically bonded to the ground plane.

FCC Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B Limits (dBuV)	
	Quasi-Peak	Average
0.150 - 0.50*	66 - 56	56 - 46
0.5 – 5.0	56	46
5.0 - 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

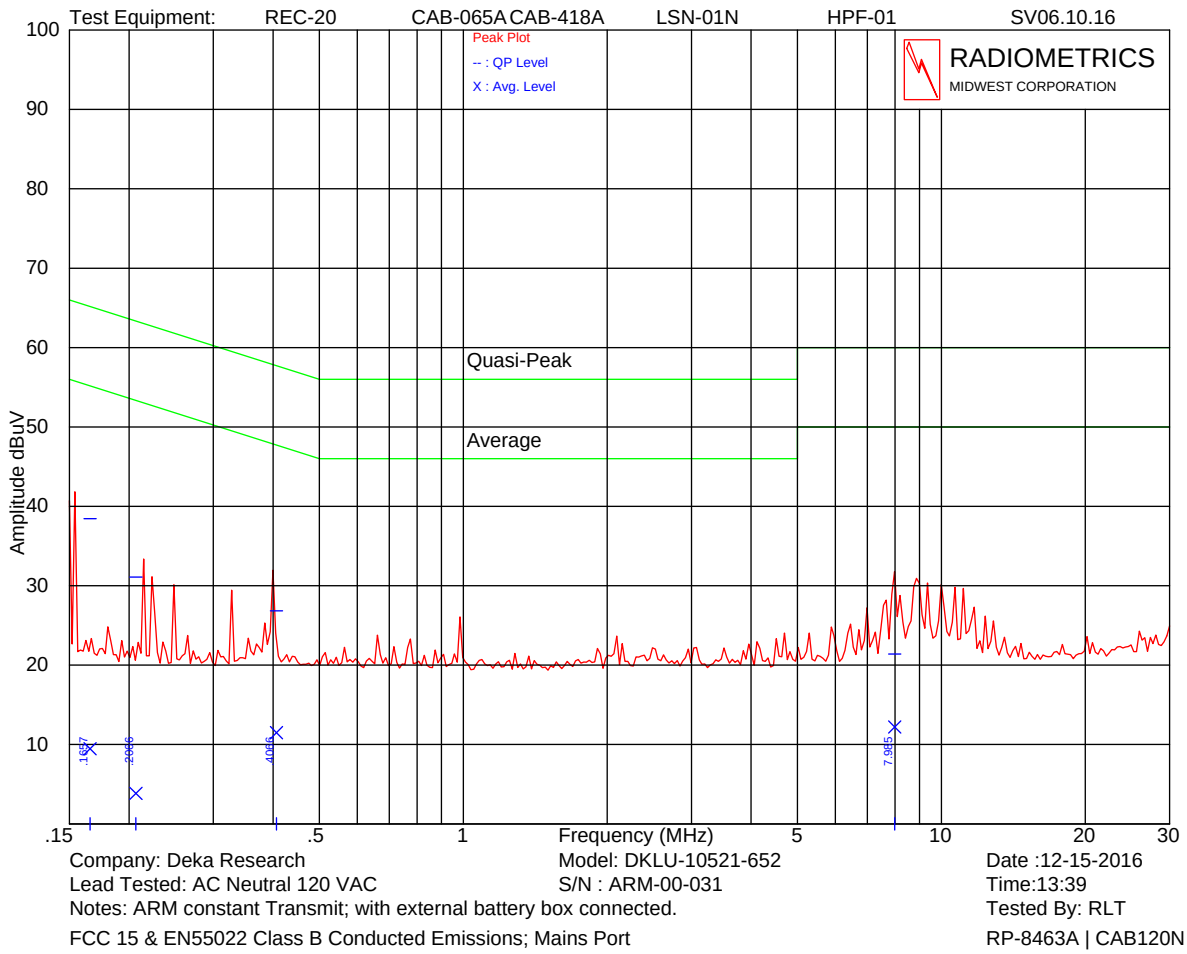
The initial step in collecting conducted data is a peak detector scan and the plotting of the measurement range. Significant peaks are then marked as shown on the following table, and these signals are then measured with the quasi-peak detector. The following represents the worst case emissions from EUT charger power cord, after testing all modes of operation.

Test Date : December 15, 2016
The Amplitude is the final corrected value with cable and LISN Loss.



Company name should be Mobius Bionics, LLC

Frequency (MHz)	QP Amplitude (dBuV)	QP Limit (dBuV)	Average Amplitude (dBuV)	Average Limit (dBuV)	Margin (dB)
0.164	37.5	65.2	9.1	55.2	27.7
0.182	33.5	64.4	8.1	54.4	30.9
8.997	29.4	60.0	17.7	50.0	30.6

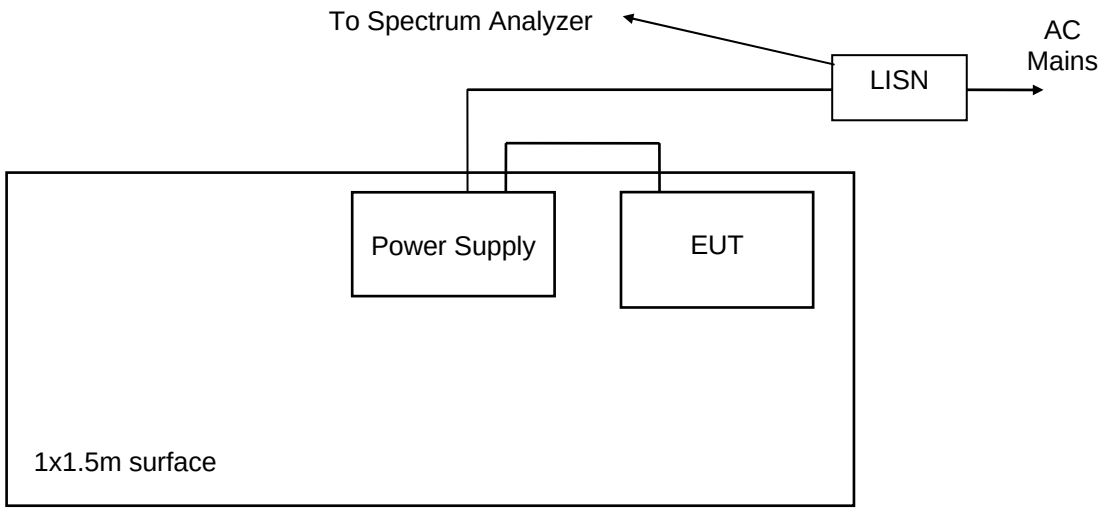


Company name should be Mobius Bionics, LLC

Frequency (MHz)	QP Amplitude (dBuV)	QP Limit (dBuV)	Average Amplitude (dBuV)	Average Limit (dBuV)	Margin (dB)
0.166	38.4	65.2	9.5	55.2	26.7
0.207	31.1	63.3	3.8	53.3	32.3
0.407	26.8	57.7	11.5	47.7	30.9
7.986	21.4	60.0	12.2	50.0	37.8

Judgment: Passed by at least 10 dB

Figure 1. Conducted Emissions Test Setup



Notes:
- LISN's at least 80 cm from EUT chassis
- Vertical conductive plane 40 cm from rear of table top
- EUT power cord bundled

11.2 Radiated RF Emissions

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. The radiated emission measurements were performed with a spectrum analyzer. The bandwidth used from 150 kHz to 30 MHz is 9 or 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz, a 1 MHz bandwidth is used. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists. A harmonic mixer was used from 18 to 25 GHz. Figure 4 herein lists the details of the test equipment used during radiated emissions tests.

The EUT was rotated through three orthogonal axis as per 5.10.1 of ANSI C63.10 during the radiated tests.

Final radiated emissions measurements were performed inside of an anechoic chamber at a test distance of 3 meters. The anechoic chamber is designated as Chamber E. This Chamber meets the Site Attenuation requirements of ANSI C63.4 and CISPR 16-1. Chamber E is located at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The entire frequency range from 30 to 25,000 MHz was slowly scanned with particular attention paid to those frequency ranges which appeared high. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded. All measurements may be performed using either the peak, average or quasi-peak detector functions. If the peak detector data exceeds or is marginally close to the limits, the measurements are repeated using a quasi-peak detector or average function as required by the specification for final determination of compliance.

The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground.

11.2.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + CF - AG + HPF + PKA

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain
PKA = Peak to Average Factor (This is only used for average measurements above 1 GHz)

The Peak to average factor is used when average measurements are required. It is calculated by the highest duty cycle in percent over any 100mS transmission. The factor in dB is 20 * Log(Duty cycle/100).

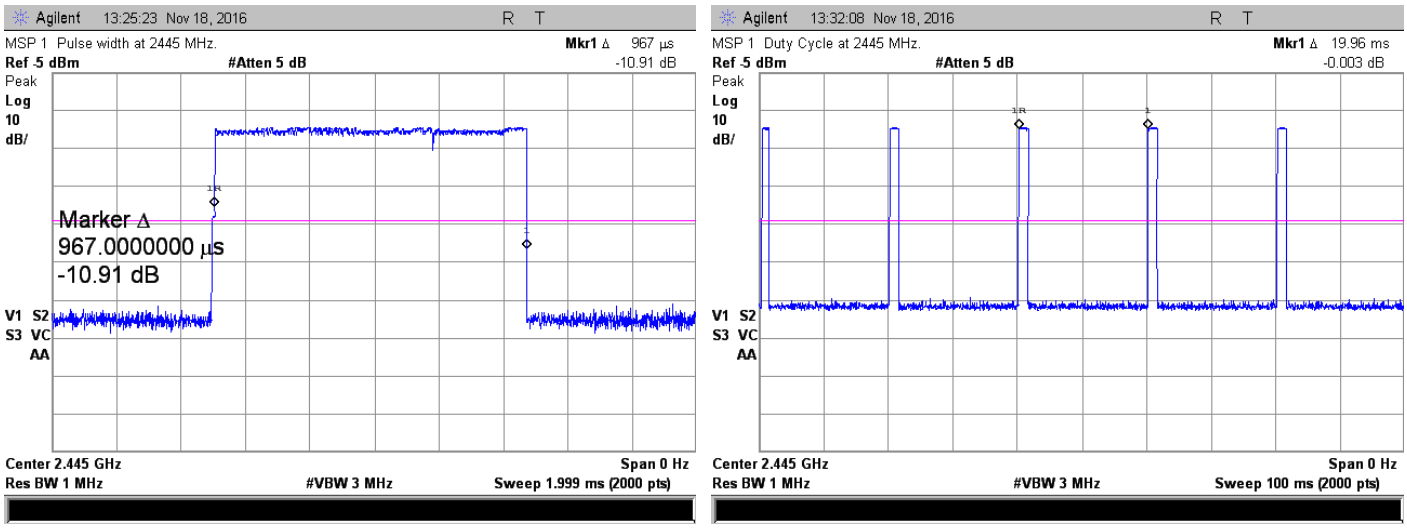
Note: The actual FCC limits are in uV/m. The data in the results table coverted the limits to dBuV/m.
100 uV/m = 40.0 dBuV/m
150 uV/m = 43.5 dBuV/m
200 uV/m = 46.0 dBuV/m
500 uV/m = 54.0 dBuV/m

11.2.2 Duty Cycle

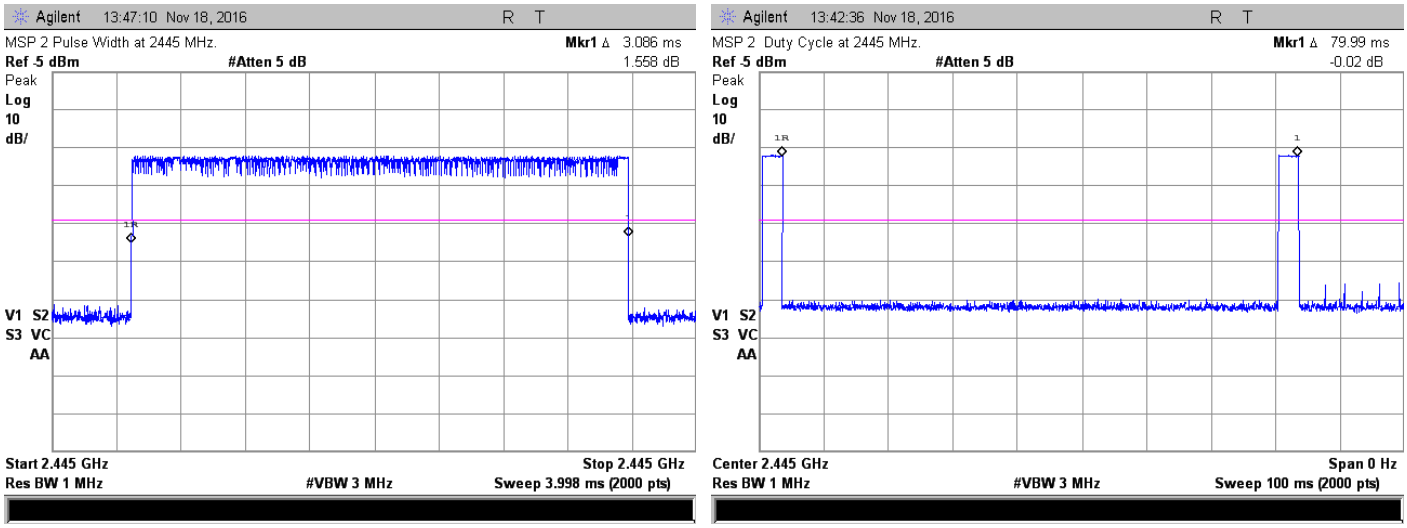
The Peak to average factor is calculated by the highest duty cycle in percent over any 100mS transmission. The factor in dB is 20 * Log(Duty cycle/100).

MSP1: The transmitter operates for a maximum duration of 0.967x5 ms in any 100 ms interval for a **4.835%** maximum duty cycle. 20 Log*(4.835mSec/100mSec) = -26.3 dB Peak to average Correction factor.

MSP2: The transmitter operates for a maximum duration of 3.086x2 ms in any 100 ms interval for a **6.172%** maximum duty cycle. 20 Log*(6.172mSec/100mSec) = -24.2 dB Peak to average Correction factor.



MSP1 Duty Cycle



MSP2 Duty Cycle

11.2.3 Radiated Emissions Test Results

11.2.3.1 Emissions Below 1 GHz

Test Date	11/5, 11/14 & 12/16/2016
Test Distance	3 Meters
Specification	FCC Part 15.209 & 15.249
Tested by	Richard Tichgelaar, Chris Dalessio
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP

MSP1

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor	Cable & Amp Factors	Dist Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
34.4	41.5	P	H	11.5	-28.3	0.0	24.6	40.0	15.4	
60.8	47.4	P	H	8.9	-28.2	0.0	28.1	40.0	11.9	
72.9	41.9	P	H	6.4	-28.0	0.0	20.2	40.0	19.8	
90.5	41.9	P	H	9.9	-27.9	0.0	23.9	43.5	19.6	
125.2	47.6	P	H	12.1	-27.8	0.0	31.9	43.5	11.6	
130.6	40.2	P	H	11.8	-27.7	0.0	24.3	43.5	19.2	
149.9	47.9	P	H	13.2	-27.7	0.0	33.5	43.5	10.0	
159.8	43.8	P	H	15.0	-27.6	0.0	31.2	43.5	12.3	
175.2	40.8	P	H	16.6	-27.6	0.0	29.9	43.5	13.6	
212.6	42.3	P	H	15.0	-27.5	0.0	29.9	43.5	13.6	
231.9	35.8	P	H	14.7	-27.4	0.0	23.1	46.0	22.9	
283.1	40.5	P	H	13.6	-27.3	0.0	26.8	46.0	19.2	
320.0	38.6	P	H	13.7	-27.3	0.0	25.0	46.0	21.0	
348.1	38.5	P	H	14.0	-27.2	0.0	25.3	46.0	20.7	
391.9	36.8	P	H	15.1	-27.2	0.0	24.7	46.0	21.3	
480.0	34.1	P	H	17.8	-26.7	0.0	25.2	46.0	20.8	
592.5	34.7	P	H	18.3	-26.3	0.0	26.7	46.0	19.3	
872.5	27.2	P	H	23.0	-25.3	0.0	24.9	46.0	21.1	
31.6	51.1	P	V	11.2	-28.3	0.0	34.0	40.0	6.0	
32.2	40.9	P	V	11.3	-28.3	0.0	23.9	40.0	16.1	
46.0	40.2	P	V	11.9	-28.3	0.0	23.8	40.0	16.2	

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor	Cable & Amp Factors	Dist Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
60.8	41.9	P	V	8.9	-28.2	0.0	22.6	40.0	17.4	
71.8	44.9	P	V	6.5	-28.1	0.0	23.3	40.0	16.7	
96.6	44.8	P	V	11.1	-27.9	0.0	28.0	43.5	15.5	
125.2	47.6	P	V	12.1	-27.8	0.0	32.0	43.5	11.5	
149.9	42.2	P	V	13.2	-27.7	0.0	27.8	43.5	15.7	
159.8	35.8	P	V	15.0	-27.6	0.0	23.2	43.5	20.3	
175.2	36.8	P	V	16.6	-27.6	0.0	25.8	43.5	17.7	
185.6	36.4	P	V	17.2	-27.5	0.0	26.1	43.5	17.4	
215.4	34.8	P	V	14.7	-27.5	0.0	22.1	43.5	21.4	
269.4	40.4	P	V	12.6	-27.3	0.0	25.6	46.0	20.4	
286.3	42.8	P	V	13.6	-27.3	0.0	29.1	46.0	16.9	
347.5	37.6	P	V	13.9	-27.2	0.0	24.4	46.0	21.6	
373.8	36.7	P	V	14.4	-27.1	0.0	24.0	46.0	22.0	
480.0	36.5	P	V	17.8	-26.7	0.0	27.6	46.0	18.4	
523.8	31.7	P	V	17.0	-26.7	0.0	22.1	46.0	23.9	
615.0	32.0	P	V	18.7	-26.4	0.0	24.3	46.0	21.7	
628.8	31.5	P	V	19.0	-26.5	0.0	24.0	46.0	22.0	
737.5	30.1	P	V	21.0	-26.1	0.0	25.0	46.0	21.0	
880.0	30.7	P	V	22.2	-25.2	0.0	27.7	46.0	18.3	
907.5	29.9	P	V	22.1	-24.9	0.0	27.2	46.0	18.8	

MSP2

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor	Cable & Amp Factors	Dist Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
33.3	46.8	P	H	11.4	-28.3	0.0	29.8	40.0	10.2	
64.7	49.4	P	H	7.9	-28.1	0.0	29.2	40.0	10.8	
98.8	43.7	P	H	11.5	-27.9	0.0	27.4	43.5	16.1	
144.4	50.4	P	H	12.2	-27.7	0.0	34.9	43.5	8.6	
159.8	46.1	P	H	15.0	-27.6	0.0	33.5	43.5	10.0	
241.2	39.5	P	H	15.8	-27.3	0.0	28.0	46.0	18.0	
276.9	43.5	P	H	13.2	-27.3	0.0	29.4	46.0	16.6	
320.0	38.5	P	H	14.1	-27.3	0.0	25.4	46.0	20.6	
480.0	33.7	P	H	17.8	-26.7	0.0	24.8	46.0	21.2	
597.5	31.1	P	H	18.2	-26.2	0.0	23.1	46.0	22.9	
753.8	30.3	P	H	20.1	-26.1	0.0	24.3	46.0	21.7	
912.5	31.7	P	H	21.9	-24.8	0.0	28.8	46.0	17.2	
35.0	50.6	P	V	11.5	-28.3	0.0	33.8	40.0	6.2	
49.8	46.1	P	V	11.4	-28.3	0.0	29.3	40.0	10.7	
70.7	48.5	P	V	6.6	-28.1	0.0	27.0	40.0	13.0	
99.3	45.2	P	V	11.6	-27.9	0.0	29.0	43.5	14.5	
143.9	38.5	P	V	12.2	-27.7	0.0	23.0	43.5	20.5	
159.8	37.9	P	V	15.0	-27.6	0.0	25.3	43.5	18.2	
236.3	31.7	P	V	15.2	-27.4	0.0	19.5	46.0	26.5	
265.6	35.8	P	V	12.8	-27.3	0.0	21.2	46.0	24.8	
348.8	35.2	P	V	14.3	-27.2	0.0	22.3	46.0	23.7	
380.6	37.1	P	V	14.8	-27.2	0.0	24.7	46.0	21.3	
405.6	34.4	P	V	14.7	-27.1	0.0	21.9	46.0	24.1	
481.3	31.4	P	V	17.8	-26.7	0.0	22.5	46.0	23.5	
603.8	30.8	P	V	18.2	-26.2	0.0	22.8	46.0	23.2	
750.0	30.5	P	V	20.0	-26.1	0.0	24.4	46.0	21.6	

Judgment: Passed by 6.0 dB
Since all readings passed in peak, Quasi-Peak measurements were not performed.

11.2.3.2 Emissions above 1 GHz

Test Date: 11/14 & 12/16/2016
Tested by: Dave Jarvis; Chris Dalessio
Radiated Emissions per FCC 15.249

MSP1

		Spectrum Analyzer Readings									EUT	Peak	Ave	Peak	Ave	Margin
hrm	Tx	Peak			Ave	Peak			Ave	Corr.	Emission	Tot. FS		Limit		Under
		Vertical Polarization				Horizontal Polarization					Freq					
#	Freq	X	Y	Z	Max	X	Y	Z	Max	Fact.	MHz	dBuV/m		dBuV/m		Limit
1	2405	86.3	87.0	82.7	60.7	89.0	88.8	91.2	64.9	-5.6	2405.0	85.6	59.3	114	94	28.4
BE	2405	42.2	42.9	38.6	16.6	44.9	44.7	47.1	20.8	-5.6	2400.0	41.5	15.2	74	54	32.5
2	2405	45.6	44.2	49.9	23.6	44.6	44.0	48.9	22.6	2.1	4810.0	52.0	25.7	74	54	22.0
3	2405	42.1	49.7	43.8	23.4	41.4	42.1	46.2	19.9	7.0	7215.0	56.7	30.4	74	54	17.3
1	2445	87.8	88.2	88.5	62.2	91.6	89.4	88.4	65.3	-5.5	2445.0	86.1	59.8	114	94	27.9
2	2445	47.0	46.7	52.5	26.2	45.3	45.7	48.7	22.4	2.1	4890.0	54.6	28.3	74	54	19.4
3	2445	0.0	42.2	46.3	20.0	48.1	41.7	43.6	21.8	7.0	7335.0	55.1	28.8	74	54	18.9
1	2480	85.0	85.2	88.1	61.8	91.3	86.3	86.5	65.0	-5.6	2480.0	85.7	59.4	114	94	28.3
BE	2480	45.7	45.9	48.8	22.5	52.0	47.0	47.2	25.7	-5.6	2483.5	46.4	20.1	74	54	27.6
2	2480	44.9	44.2	50.1	23.8	43.4	43.8	46.0	19.7	2.4	4960.0	52.5	26.2	74	54	21.5
3	2480	45.3	45.0	48.9	22.6	41.1	45.3	50.4	24.1	7.5	7440.0	57.9	31.6	74	54	16.1
Column numbers (see below for explanations)																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

MSP2

		Spectrum Analyzer Readings									EUT	Peak	Ave	Peak	Ave	Margin
hrm	Tx	Peak			Ave	Peak			Ave	Corr.	Emission	Tot. FS		Limit		Under
		Vertical Polarization				Horizontal Polarization					Freq					
#	Freq	X	Y	Z	Max	X	Y	Z	Max	Fact.	MHz	dBuV/m		dBuV/m		Limit
1	2405	84.6	91.5	84.2	67.3	86.1	84.1	94.5	70.3	-5.6	2405.0	88.9	64.7	114	94	25.1
BE	2405	38.8	45.7	38.4	21.5	40.3	38.3	48.7	24.5	-5.6	2400.0	43.1	18.9	74	54	30.9
2	2405	43.0	42.6	44.0	19.8	42.5	46.9	42.7	22.7	2.1	4810.0	49.0	24.8	74	54	25.0
3	2405	40.4	40.7	40.4	16.5	40.6	41.0	45.9	21.7	6.8	7215.0	52.7	28.5	74	54	21.3
1	2445	84.1	92.3	83.6	68.1	84.8	83.2	92.3	68.1	-5.2	2445.0	87.1	62.9	114	94	26.9
2	2445	43.2	48.9	43.1	24.7	42.1	45.9	42.3	21.7	2.4	4890.0	51.3	27.1	74	54	22.7
3	2445	0.0	46.8	40.9	22.6	44.0	41.0	41.1	19.8	7.2	7335.0	54.0	29.8	74	54	20.0
1	2480	84.3	88.6	83.1	64.4	85.2	82.9	91.3	67.1	-5.3	2480.0	86.0	61.8	114	94	28.0
BE	2480	46.7	51.0	45.5	26.8	47.6	45.3	53.7	29.5	-5.3	2483.5	48.4	24.2	74	54	25.6
2	2480	42.0	41.9	42.8	18.6	41.8	41.4	48.9	24.7	2.4	4960.0	51.3	27.1	74	54	22.7
3	2480	42.0	43.2	40.9	19.0	40.5	45.3	40.6	21.1	7.5	7440.0	52.8	28.6	74	54	21.2
Column numbers (see below for explanations)																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

Column #1. hrm = Harmonic; BE = Band Edge emissions
Column #2. Frequency of Transmitter.
Column #3. Uncorrected readings from the spectrum analyzer with First Axis Rotation.
Column #4. Uncorrected readings from the spectrum analyzer with Second Axis Rotation.
Column #5. Uncorrected readings from the spectrum analyzer with Third Axis Rotation.
Column #6. Average Reading based on peak reading reduced by the Duty cycle correction
Column #7. Uncorrected readings from the spectrum analyzer with First Axis Rotation.

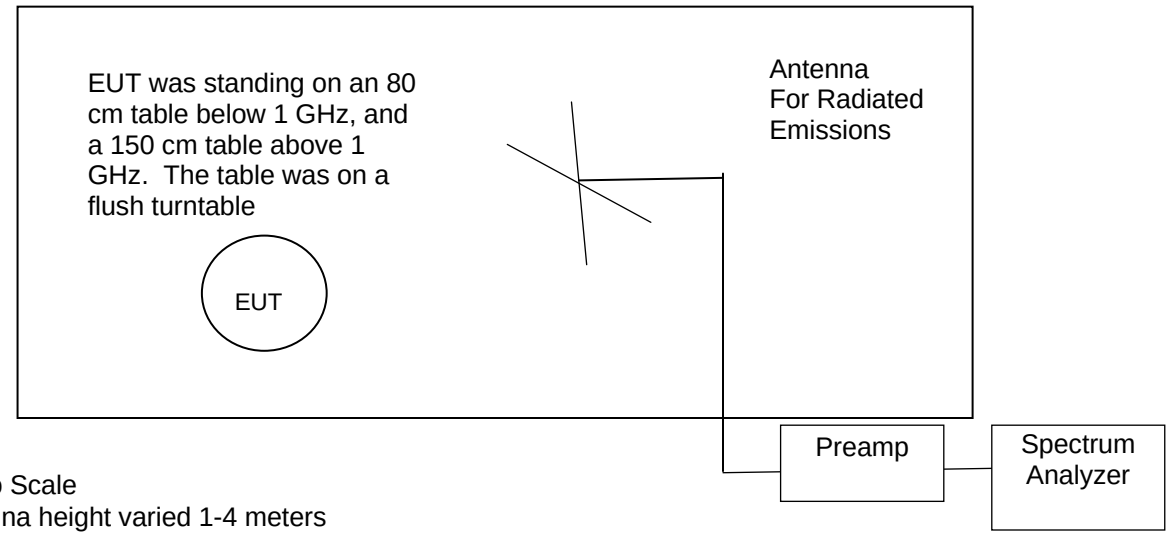
Column #8. Uncorrected readings from the spectrum analyzer with Second Axis Rotation.
Column #9. Uncorrected readings from the spectrum analyzer with Third Axis Rotation.
Column #10. Average Reading based on peak reading reduced by the Duty cycle correction
Column #11. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor
Column #12. Frequency of Tested Emission
Column #13. Highest peak field strength at listed frequency.
Column #14. Highest Average field strength at listed frequency.
Column #15. Peak Limit.
Column #16. Average Limit.
Column #17. The margin (last column) is the worst case margin under the peak or average limits for that row.

All emissions outside of the band from 2400 to 2483.5 were below the limits of 15.209.
No other Emissions were detected from 30 to 25,000 MHz within 10 dB of the limits.

Overall Judgment: Passed by at least 10 dB

Figure 2. Drawing of Radiated Emissions Setup

Chamber E, anechoic



Notes:
- Not to Scale
- Antenna height varied 1-4 meters
- Distance from antenna to tested system is 3 meters
- AC cords not shown. They are connected to AC outlet with low-pass filter on turntable

Frequency Range	Receive Antenna	Pre-Amplifier	Spectrum Analyzer
30 to 200 MHz	ANT-04	AMP-22	REC-11
200 to 1000 MHz	ANT-08	AMP-22	REC-11
1 to 10 GHz	ANT-13	AMP-05	REC-11
10 to 18 GHz	ANT-36	AMP-20	REC-11
18 to 25 GHz	ANT-48	AMP-29	REC-08; MXR-01

11.3 Occupied Bandwidth Data

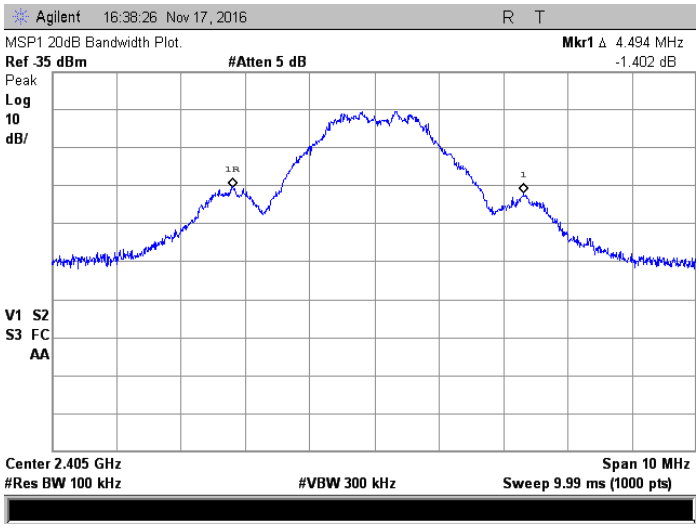
The occupied bandwidth of the RF output was measured using a spectrum analyzer. The bandwidth was measured using the peak detector function and a narrow resolution bandwidth.

A broadband antenna was used to receive the modulated signal. The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The spectrum analyzer display was digitized and plotted. A limit was drawn on the plots based on the level of the modulated carrier. The plots of the occupied bandwidth for the EUT are supplied on the following page.

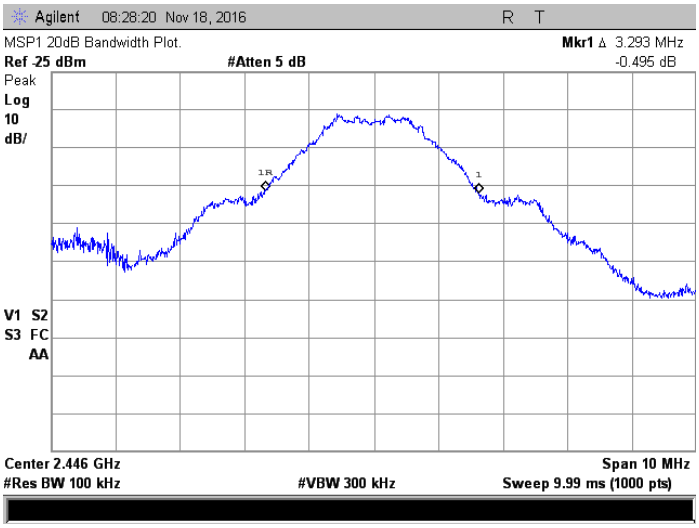
Test Date: 11/18/2016
Tested by: Richard Tichgelaar

EUT	EUT MHz	20 dB BW MHz
MSP1	2405	4.494
MSP1	2445	3.293
MSP1	2480	3.033
MSP2	2405	3.333
MSP2	2445	3.133
MSP2	2480	3.443

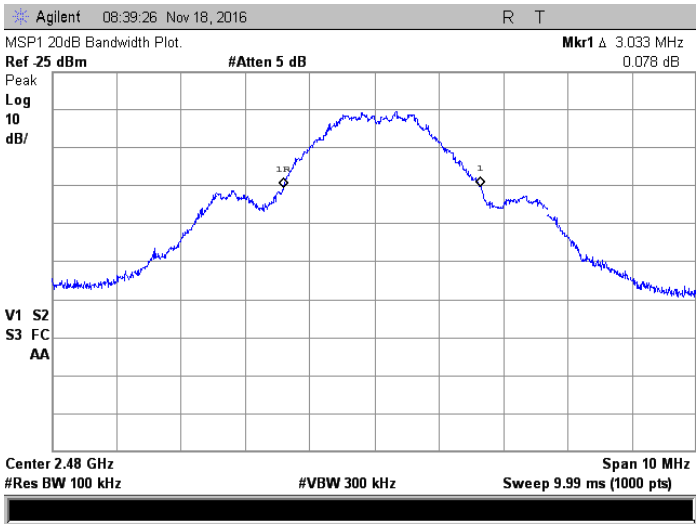
Figure 3. Occupied Bandwidth Plots



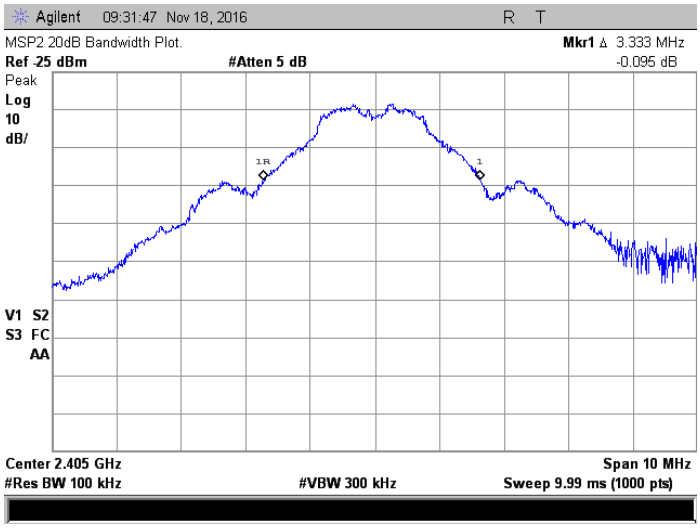
MSP1; 2405 MHz



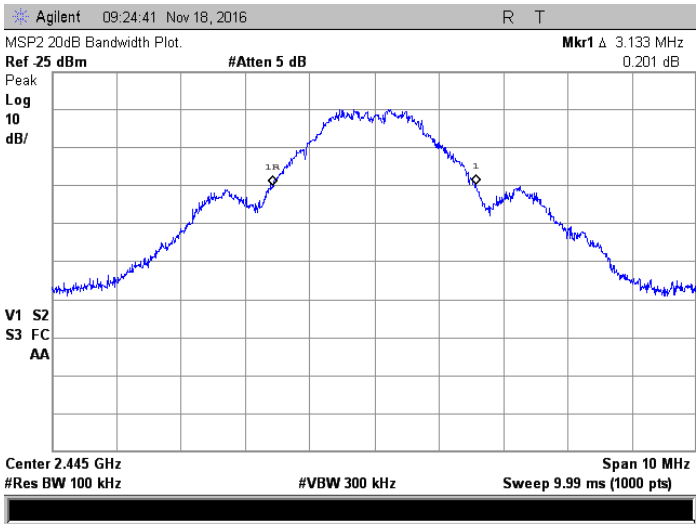
MSP1; 2445 MHz



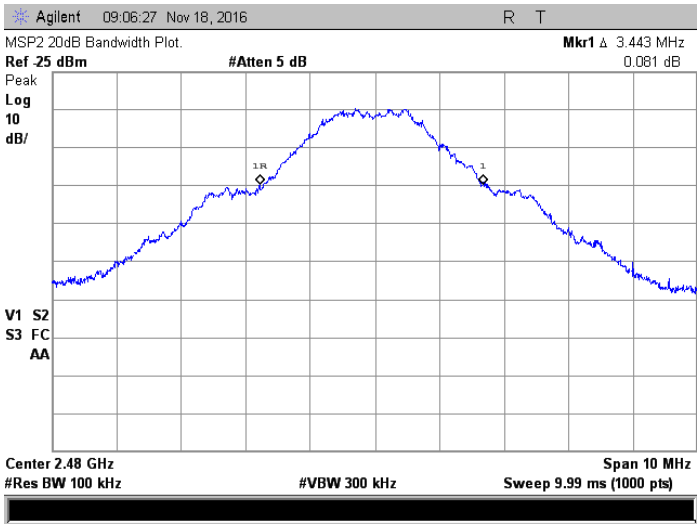
MSP1; 2480 MHz



MSP1; 2405 MHz



MSP2; 2445 MHz



MSP2; 2480 MHz

11.3.1 Measurement Instrumentation Uncertainty

Measurement	Uncertainty
Conducted Emissions, LISN method, 150 kHz to 30 MHz	2.7 dB
Radiated Emissions, E-field, 3 meters, 30 to 200 MHz	3.3 dB
Radiated Emissions, E-field, 3 meters, 200 to 1000 MHz	4.9 dB
Radiated Emissions, E-field, 3 meters, 1 to 18 GHz	4.8 dB
Bandwidth using marker delta method at a span of 10 MHz	4 kHz
Temperature THM-02	0.6 Deg C

The uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2 in accordance with CISPR 16-4-2.